

REMARKS/ARGUMENTS

Reconsideration of this application in light of the above amendments and following comments is courteously solicited.

Claims 1-13 have been cancelled in favor of new claims 14-23. With regard to the subject matter of the present invention as now claimed in new claims 14-23, attention is drawn to Page 2 of the instant specification and, particularly, the second paragraph thereof. That portion of the instant specification points out with specificity the problems with the prior art vis-à-vis heat deterioration and workability of the prior art. As pointed out, a large electric current flowing through a conductor heats the conductor to thereby cause heat and thermal stress exerted on the Hall effect sensor in the package so that there is a likelihood of deterioration of electric property in the Hall effect sensor and degradation of mechanical property in the plastic package. Also, the conductor requires its high machining accuracy enough to mount the current detector in position on a surface of a substrate keeping the conductor at a same level as lead terminals, thus lowering the productivity and yield.

The electric current protector of the present invention as now claimed in the claims presented herein overcome the problems noted above with regard to the prior art. Specifically, new independent claim 14 sets forth the following:

- "1. Reinforcement tube (8) is disposed in core (7) to define an opening (5) inside reinforcement tube (8);
2. Hall effect sensor (2) is disposed in core (7) out of reinforcement tube (8);
3. Conductor (6) is loosely and irremovably disposed in opening (5) of reinforcement (8) with a gap for longitudinal movement of conductor (6) in a limited range; and
4. Conductor (6) is in spaced relation to Hall effect sensor (2) which detects electric current flowing

through conductor (6)."

Loose arrangement of conductor (6) provides an air gap or air layer between conductor (6) and plastic package (4) in opening (5) to prevent close contact between conductor (6) and plastic package (4). Accordingly, heat and heat stress that may be produced in conductor (6) by a large electric current flowing through conductor (6) during measurement, are not transmitted to Hall effect sensor (2) and plastic package (4) by air gap while a part of heat in the conductor (6) is radiated into air in opening (5). Therefore, loose arrangement of conductor (6) can restrict or reduce deterioration of electric property in Hall sensor (2) and degradation of mechanical property in plastic package (4) by heat and heat stress transmitted from conductor (6) for conducting large electric current. Moreover, the arrangement ensures and facilitates attachment of the detector in position on a surface of a substrate and enables to maintain conductor (6) at the same level as lead terminals (3). In addition, Reinforcement tube 8 can reduce impact upon conductor (6) by external noise such as change in electric field; can protect core (7) from damage by contact to conductor (6); and prevents inflow of resin into opening (5) inside reinforcement tube 8. Accordingly, the electric current detector according to the present invention may restrain deterioration of electric property in Hall effect sensor (2) and degradation of mechanical property in plastic package (4) under large electric current flowing through conductor (6) which produces heat and heat stress in a conductor.

U.S. Patent 6,781,359 discloses an integrated current sensor 10 which includes a current-carrying conductor 16 for receiving portions of a Hall effect sensor 12 and a magnetic core 24; and a molded body 28 disposed over magnetic core 24, a

portion of conductor 16 and Hall effect sensor 12 to reduce movement of the elements relative to each other. Accordingly, conductor 16 of this reference is firmly secured by molded body 28 against movement, and therefore, it is apparent that the sensor 10 of this reference would give rise to heat of sensor 12, magnetic core 24 and molded body 28 and workability defect of conductor 16.

U.S. Patent 6,515,468 only exhibits a current sensor which comprises a sensor conductor 20 secured to cabinet 10.

U.S. Patent 6,545,456 shows a current sensor package comprising a core 26 securely fixed by insulative material 22.

U.S. Patent 6,426,617 discloses a current sensor system 20 with Hall generator 22 without encapsulating package.

None of the cited and applied references disclose any reinforcement tube for defining opening inside the reinforcement tube to loosely and irremovably mount a conductor in the opening of the reinforcement with a gap for longitudinal movement of the conductor in a limited range so that a Hall effect sensor is disposed out of reinforcement tube.

In light of the foregoing, it is submitted that claim 14 and the claims which depend therefrom patentable define over the art of record and an early indication of same is respectfully requested.

An earnest and thorough attempt has been made by the undersigned to resolve the outstanding issues in this case and place same in condition for allowance. If the Examiner has any questions or feels that a telephone or personal interview would be helpful in resolving any outstanding issues which remain in this application after consideration of this amendment, the Examiner is courteously invited to telephone the undersigned and the same would be gratefully appreciated.

It is submitted that the claims as amended herein patentably define over the art relied on by the Examiner and early allowance of same is courteously solicited.

If any fees are required in connection with this case, it is respectfully requested that they be charged to Deposit Account No. 02-0184.

Respectfully submitted,
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I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313" on July 12, 2005.


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